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A MODEL OF FIRM'S PRODUCTION AND SALES DECISIONAL SUBSYSTEMS

Abstract. *Fluctuations in demand have always been challenging to companies willing to identify the best responses to market changes and take full advantage of existing opportunities. As demand varies both quantitatively and structurally, anticipating these changes might turn out to be quite difficult.*
The decisions companies have to make range from decisions regarding production and prices of goods, to those referring to the allocation of profit that might include inducing artificial demand to determine the customers to buy more.
In this paper we present a model that considers both production and sales subsystems and develop a computer program to simulate the dynamic evolution of a firm, taking into consideration the above mentioned decisions.

Keywords: *modeling production system, modeling sales system, modeling firms, profit distribution, dynamic model, optimization, scenarios, simulation.*

JEL Classification: C61, C63, D24, L11

1. Overview of the model

The model consists of a simultaneous approach of both production and sales subsystems and provides a simulation of the **dynamic** evolution of a firm under uncertainty.

We consider the case of a typical company producing its goods by using **capital** and **labor** as production factors, materialized in terms of costs as **depreciation** and **wages**. The quantity of goods produced corresponds to an estimate of the potential market demand.

To highlight the importance of the production structure, we assume the company produces two goods characterized by a substitutability relationship imposed by the demand structure. We employ a Marshallian demand function that assumes optimal utility under income restrictions.

Therefore, the model connects the firm's **internal** decisional mechanism of production (which is **quantitative** in the levels of production factors and **qualitative** considering the decision regarding the production structure), with the

internal mechanism for determining the selling price (restricted due to the necessity of covering production costs) and the **external** decisional mechanism of the market (represented by optimal consumption under income restrictions).

There are always two determinants of consumption: the **need** and the **choice**. Consumer need lead to conscious and voluntary allocation of monetary funds for purchasing the goods, while consumer choice is determined by conjunctural factors, such as: advertising, that induce the desire to consume, fear of adverse movements in the price of goods due to increases in prices of raw materials, or structural deficiencies on the qualified labor market, which make the consumer create supplementary stocks.

By confronting the company's **supply** with market **demand** for a specific time frame, we obtain the **traded** quantities, which is reflected by two financial revenue flows (corresponding to the selling of each type of goods), and modifications in the stocks of goods that entails certain **storage costs**.

As a result, the company records a profit level given by the difference between **operating income,** represented by total revenue minus total cost of production, and the **total cost of storage** for the **quantities stored** at the time (sum of previous inventories and unsold production).

The efficient continuation of the production process implies the allocation of the current level of profit, considering the following:

- the need to ensure the appropriate level of liquidity to avoid exposure to financial attacks by third parties and take overs;
- the requirement to ensure a good level of productive capital, to meet future market demand;
- the necessity to ensure workforce motivation and effective involvement in the production process;
- the provision of information regarding possible consumption structure of the market, with major implications in the decisional process of production structure;
- the desire to induce an increase of consumption of both goods (through general advertising) or focus on only one (through targeted advertising of a certain product).

All these decisions are important for business development in subsequent periods. Establishing a higher level of liquidity would increase the available cash, which helps avoid potential financial blockages in the current activity of the firm and ensure more stability with respect to external funding options. A higher level of capital may lead to substitution of labor, if unexpected increases in wages occur, or higher production that may yield higher market shares, if determined by an increase in demand.

The model is depicted by the following relations:

Equation describing:	**Relation form:**	
Production - quantity	$Q(\cdot) = A \cdot K(\cdot)^{\alpha} \cdot L(\cdot)^{\beta(M_L(\cdot))}$	(1)
Production - quality	$Q(\cdot) = pd_1 \cdot Q_1(\cdot) + pd_2 \cdot Q_2(\cdot)$	(2)
Firm's Supply	$S_i(\cdot) = Q_i(\cdot) + St_i(\cdot) \text{ cu } i \in 1,2$	(3)
Market's Demand	$D_i(\cdot) = DP_i(\cdot) + Dp_i(\cdot) \left\| \begin{cases} V(\cdot) = \sum_{i=1}^{2} p_i \cdot Dp_i(\cdot) \\ \max U(\cdot) = \prod_{i=1}^{2} Dp_i(\cdot)^{\alpha_i(p)} \end{cases} \right.$	(4)
Traded Quantity	$QD_i(\cdot) = \min(S_i(\cdot), D_i(\cdot))$	(5)
Stocks	$\dot{St}_i(\cdot) = Q_i(\cdot) - QD_i(\cdot) \left\| St_i(0) + \int_0^{\tau} Q_i(\cdot)dt \geq \int_0^{\tau} QD_i(\cdot)dt, \right.$ $\forall \tau \in [0,T]$	(6)
Profit – formation	$\prod(\cdot) = \sum_{i=1}^{2} p_i(\cdot) QD_i(\cdot) - (p_K(\cdot) a \cdot K(\cdot) + p_L(\cdot) L(\cdot)) - \sum_{i=1}^{2} c_i(\cdot) St_i(\cdot)$	(7)
Capital – dynamics	$\dot{K}(\cdot) = I(\cdot) - a \cdot K(\cdot)$	(8)
Profit – distribution	$\prod(\cdot) = I(\cdot) + M_F(\cdot) + M_L(\cdot) + Fp(t) + P(\cdot) + \sum_{i=1}^{2} P_i(\cdot)$	(9)
Objective Function	$Opt = \int_0^{T} M_F(\cdot) e^{-i \cdot t} \cdot dt$	(10)

where $Q(\cdot)$ represents the total production of the firm, $K(\cdot)$ is the current level of capital, $L(\cdot)$ indicates the current level of labor, $\beta(M_L(\cdot))$ is the labor elasticity with respect to financial motivation $M_L(\cdot)$, and α represents productive capital elasticity (**equation 1**). The firm decides to allocate production capacities to produce good 1 $Q_1(\cdot)$, and good 2 $Q_2(\cdot)$, and their weights in total production are given by coefficients pd_1 and pd_2 (**equation 2**).

S_i represents the firm's supply of good *i* on the market, resulted from the production, Q_i, and the existing stock, St_i - (**equation 3**) while D_i symbolizes market demand for good *i*, as the sum of **optional** demand, induced by advertising mechanisms, DP_i, which necessitates the allocation of funds denoted P_i, and the demand resulted from the **need** of consumption, Dp_i, which is the solution of the utility maximization problem under disposable income restriction (**equation 4**).

QD_i symbolizes the quantity of good *i* traded, as the minimum between demand and supply of that good (**equation 5**), while St_i is the stock of good *i*, whose variation is given by the difference between production and sales, under the restriction that at each previous time the stock is at least equal to zero (**equation 6**).

$\prod$ describes the level of profit recorded at moment t, as the difference between revenues and total costs (including stock costs) - (**equation 7**), that is then distributed as investment I, liquidities M_F, bonuses and other motivational elements of labor M_L, funds for market research and information gathering about demand, both quantitatively and structurally Fp, funds for advertising P, as well as funds allocated to promotional selling P_i - (**equation 9**).

K is the current level of capital, whose dynamics is given by the investment I, reduced by depreciation $a \cdot K$ (**equation 8**).

The structure of the objective function symbolizes the present value of unused financial liquidities (with other possible uses- provisions, bank deposits, etc.) of firm (**equation 10**).

The motivations for such an approach consist, on one hand, of the need to take the interests of labor force into account in order to use it more efficiently (employment elasticity becomes variable) and, on the other hand, relies on the growing trend to use advertising to **generate** more demand for a company's products. Another important aspect is the company's need to be informed about the decisional elements (quality, price, level of savings, other cyclical macroeconomic issues) that consumers have in mind when they manifest the need or the choice. Also, the two subsystems (the production and sales) have interconnections through the set of decisions that can lead to significant mutual influences, especially under difficult economic conditions.

In the model above, there is a set of restrictions imposed on variables, some of which are tangentially presented within relations (1-10). Except this, it is clear that the generally accepted condition used in our model refers to the impossibility of disinvestments ($I \geq 0$), and that other elements of profit distribution $M_F, M_L, Fp(t), P, P_i$ are positive if the company's profit

is above zero. If the company does not make profit but records a loss, $I, M_L, Fp(t), P, P_i$ become all zero, and $M_F \leq 0$.

Such a model is difficult to solve by conventional analytical methods (Pontreaghin Principle). Therefore, we considered useful to employ a discretized model approach in which the objective function could be used as an indicator of the opportunity of the decisions made by the company, without exhaustively searching for the optimal decision.

In this case, the model becomes:

Equation describing	**Relation form:**	
Production - quantity	$Q_t = A \cdot K_t^{\alpha} \cdot L_t^{\beta}$	(1)
Production - quality	$Q_t = pd_1 \cdot Q_{1,t} + pd_2 \cdot Q_{2,t}$	(2)
Firm's Supply	$S_{i,t} = Q_{i,t} + St_{i,t-1}$ cu $i \in 1,2$	(3)
Market's Demand	$D_{i,t} = DP_{i,t-1} + Dp_{i,t} \left\| \begin{cases} V_t = \sum_{i=1}^{2} p_i \cdot Dp_{i,t} \\ \max U_t = \prod_{i=1}^{2} Dp_{i,t}^{u_i} \end{cases} \right.$	(4)
Traded Quantity	$QD_{i,t} = \min(S_{i,t}, D_{i,t})$	(5)
Stock	$St_{i,t} = St_{i,t-1} + Q_{i,t} - QD_{i,t} \quad \left\| St_{i,0} \geq 0 \wedge St_{i,t} \geq 0, \forall \tau \in \right.$	(6)
Profit – formation	$\Pi_t = \sum_{i=1}^{2} p_{i,t} \cdot QD_{i,t} - (p_{K,t} \cdot a \cdot K_t + p_{L,t} \cdot L_t) - \sum_{i=1}^{2} c_{i,t} \cdot St_{i,t}$	(7)
Capital – dynamics	$K_t = K_{t-1} + I_{t-1} - a \cdot K_{t-1}$	(8)
Profit – distribution	$\Pi_t = I_t + M_{F,t} + M_{L,t} + Fp_t + P_t + \sum_{i=1}^{2} P_{i,t}$	(9)
Objective Function	$Opt = \sum_{\tau=1}^{t} M_{F,\tau} \cdot e^{-i \cdot \tau}$	(10)

with all elements similar to those defined in time-continuous case.

Solving the discretized model is also difficult when there is a sufficiently large number of decision variables. Therefore, a useful alternative is to use scenarios, reflecting, at least in a limited useful manner, the features of the presented situation.

2. The description of the calculation program

To implement the proposed discretized model, the Visual Basic programming language included in Office2003, 2007 and 2010 was used. This option has the main advantage of presenting the necessary data in Excel spreadsheets, which eases the further processing and graphical representation of results.

The program is relatively simply structured, with the main trigger mechanism consisting of a command button that contains the necessary code that runs the simulation of firm's evolution in the attached event Click. To establish company-specific conditions, certain formulas are required. These are included in the spreadsheet, as follows:

- J11 =$F$1*H11*E11+I11*F11;
- K11 =$C$1*($F$1*H11)^$H$1*I11^$I$1;
- O11 =L11*K11;
- P11 =M11*K11;
- AB11 =MIN(O11+IF(ISNUMBER(AF10),AF10,0),Y11);
- AC11 =MIN(Z11,P11+IF(ISNUMBER(AG10),AG10,0));
- AD11 =AB11*R11+AC11*S11;
- AF11 =O11-AB11+IF(ISNUMBER(AF10),AF10,0);
- AG11 =P11-AC11+IF(ISNUMBER(AG10),AG10,0);
- AI11 =$AI$1*AF11;
- AJ11 =$AJ$1*AG11;
- AL11 =AD11-J11-AI11-AJ11.

The presentation of program's source code will track all aspects mentioned in Chapter 1. It starts with the description of the main function attached to the Click event, that appears once the Evolution button is pressed.

```
' declare variables
Dim T As Integer ' time horizon
Dim i As Integer ' current period
Dim j As Integer ' contor
Dim Col(1 To 7) As String
Dim vb1 As Boolean
Dim NorocFM As Double   ' the influence of super-productive FM
Dim nr_crt_FM As Double ' the influence of increase in elasticity of FM
Dim totalMotivatieFM As Double 'total cumulative incentives for generating effect
Dim prag As Double      ' threshold effect of the incentives
Dim InfoPiaţă1 As String ' expected market share for good1 considering its previous price
Dim Elast1 As Single    ' estimated elasticity for good 1
```

The function starts by declaring variables used in the program: the time frame for running the simulation, the current calculation period, counters for the

required iterations, the massive for checking the existence of initial data required and other variables whose roles are described later in the paper.

The following code aims at verifying the existence of the elements required for running the program (initial moment, liquidity, cost of capital, initial level of capital and market conditions – available income, marginal utility of goods).

```
' checking the initialisation of data
Col(1) = "A": Col(2) = "C": Col(3) = "E": Col(4) = "H": Col(5) = "U": Col(6) =
"V": Col(7) = "W"
vb1 = True
Do
For j = 1 To 7
vb1 = vb1 And (Col(j) <> "")
If vb1 = False Then
MsgBox "No data found in location " & Col(j) & "11!", vbOKOnly
Worksheets("Foaie1").Range(Col(j) & "11") = InputBox("Introduce initial
element " & Worksheets("Foaie1").Range(Col(j) & "10") & ":",
Worksheets("Foaie1").Range(Col(j) & "10"))
End If
Next j
Loop Until vb1
```

The following 4 lines of code are initializations of variables required in the calculation program:

```
nr_crt_FM = 1 ' labor has initial elasticity
totalMotivatieFM = 0
prag = 1000
Elast1 = 0.5
```

After determining the interactive time frame for simulation, the company will have to make employment decisions and its offer will depend on the level of payment and its decision regarding a more efficient structuring of the production, considering the prices:

```
' determining the time horizon
T = InputBox("Time frame :", "for how many periods are we running the simulation?", 10)
Randomize

' Firms decisions
For i = 1 To T
' capital cost
Worksheets("Foaie1").Range("E" & 10 + i) = Worksheets("Foaie1").Range("E11")
' salary offered
Worksheets("Foaie1").Range("F" & 10 + i) = InputBox("Salary level: ", "Salary", 5)
NorocFM = Rnd - 0.5
If NorocFM > 0 Then
Worksheets("Foaie1").Range("I" & 10 + i).Interior.Color = RGB(195, 160, 255) ' violet
Else
```

```
Worksheets("Foaie1").Range("I" & 10 + i).Interior.Color = RGB(230, 250, 210) ' galbeior
End If
Worksheets("Foaie1").Range("I" & 10 + i) = 160 + Int(20 * NorocFM)
'establishing the production structure
Worksheets("Foaie1").Range("L" & 10 + i) = InputBox("Weight of good1 in total
production (Estimated elasticity for good1 is " & Elast1 & "): ", "Weight for good1",
"40%")
Worksheets("Foaie1").Range("M" & 10 + i) = (1 - Worksheets("Foaie1").Range("L" & 10
+ i)) * 100 & "%"
' Total cost of production
Worksheets("Foaie1").Range("J11").Copy (Worksheets("Foaie1").Range("J" & 10 + i))
' Total production
Worksheets("Foaie1").Range("K11").Copy (Worksheets("Foaie1").Range("K" & 10 + i))
' Quatities produced for each good
Worksheets("Foaie1").Range("O11").Copy (Worksheets("Foaie1").Range("O" & 10 + i))
Worksheets("Foaie1").Range("P11").Copy (Worksheets("Foaie1").Range("P" & 10 + i))
' Firm's established prices for goods
Worksheets("Foaie1").Range("R" & 10 + i) = InputBox("Price suggested for good 1: ",
"Price good 1", 25)
Worksheets("Foaie1").Range("S" & 10 + i) = InputBox("Price suggested for good 2: ", "
Price good 2", 10)
```

In parallel with computing elements for the current period, it is necessary to implement the calculation formulas used for the next period, which is reflected by the Copy method of Range object used previously.

Once the company establishes its prices, its consumers can make their choices known. In the first period, the demand for consumption is dependent only on the initial characteristics of the market and the price system; afterwards, the company may act in a more subtle way, through advertising mechanisms (which are either general, aiming at increasing the consumption, or targeted towards increasing the sale of a particular product). The implementation of this feature is achieved through the public procedure DecizieConsumPiață (DecisionConsumptionMarket), whose input parameter is the spreadsheet line that is called inside the procedure Evolutie_Click (Evolution_Click). The source code line that calls the function is: *DecizieConsumPiaţ ă (10 + i).*

```
Public Sub DecizieConsumPiaţ ă(linie As Integer)
Dim Income As Long
Dim price1 As Long
Dim price2 As Long
Dim util As Double, Qt1 As Long
Dim SumaCtrl As Double
'linie = InputBox("Line:", , 6)
Income = CLng(Worksheets("Foaie1").Range("U" & linie))
price1 = CLng(Worksheets("Foaie1").Range("R" & linie))
price2 = CLng(Worksheets("Foaie1").Range("S" & linie))
util = 0 ^ Worksheets("Foaie1").Range("V" & linie) * (Income / price2) ^
Worksheets("Foaie1").Range("W" & linie)
```

```
  For i = 0 To Income / price1
util2 = i ^ Worksheets("Foaie1").Range("V" & linie) * ((Income - i * price1) / price2) ^
Worksheets("Foaie1").Range("W" & linie)
If util2 > util Then
util = util2
Qt1 = i
Worksheets("Foaie2").Range("N" & linie) = Qt1
Worksheets("Foaie2").Range("O" & linie) = (Income - Qt1 * price1) / price2
End If
Next i
' is added to the initial level to retrieve the influence of columns AS and AT calculated
on previous line
Worksheets("Foaie1").Range("Y" & linie) = Qt1 + Worksheets("Foaie1").Range("Y" &
linie)
Worksheets("Foaie1").Range("Z" & linie) = (Income - Qt1 * price1) / price2 +
Worksheets("Foaie1").Range("Z" & linie)
End Sub
```

The confrontation between the supply and demand results in quantities of products that are being sold, and potential remaining stocks that could be traded during next periods, but incur storage costs that reduce profit.

```
' sales level and total revenue
Worksheets("Foaie1").Range("AB11").Copy (Worksheets("Foaie1").Range("AB" &10 + i))
Worksheets("Foaie1").Range("AC11").Copy (Worksheets("Foaie1").Range("AC" &10 + i))
Worksheets("Foaie1").Range("AD11").Copy (Worksheets("Foaie1").Range("AD"&10 + i))
' stocks level
Worksheets("Foaie1").Range("AF11").Copy (Worksheets("Foaie1").Range("AF" &10 + i))
Worksheets("Foaie1").Range("AG11").Copy (Worksheets("Foaie1").Range("AG"&10 + i))
' stock costs
Worksheets("Foaie1").Range("AI11").Copy (Worksheets("Foaie1").Range("AI" & 10 + i))
Worksheets("Foaie1").Range("AJ11").Copy (Worksheets("Foaie1").Range("AJ" & 10 + i))
' current profit
Worksheets("Foaie1").Range("AL11").Copy (Worksheets("Foaie1").Range("AL" & 10 + i))
```

The next lines in this program consider the distribution of profit for the smooth continuation of the production and sales processes. Profit can be used to increase productive capital, to motivate the employees, to study the market, to influence consumption in general or that of a certain good, as well as to ensure the liquidity, thus the financial independence and stability of the company.

```
' profit allocation
If CDbl(Worksheets("Foaie1").Range("AL" & 10 + i)) > 0 Then
Do
SumaCtrl = 0
```

```
Worksheets("Foaie1").Range("AN" & 10 + i) = InputBox("The percentage of profit
kept as liquidity (%): ", "Percent of profit as liquidity ", 40)
Worksheets("Foaie1").Range("AN" & 10 + i) = Worksheets("Foaie1").Range("AN" &
10 + i) * CInt(Worksheets("Foaie1").Range("AL" & 10 + i)) / 100
SumaCtrl = SumaCtrl + Worksheets("Foaie1").Range("AN" & 10 + i)

Worksheets("Foaie1").Range("AO" & 10 + i) = InputBox("The percentage of profit
allocated for capital increses (%): ", "Percent of profit for capital", 15)
Worksheets("Foaie1").Range("AO" & 10 + i) = Worksheets("Foaie1").Range("AO" &
10 + i) * Worksheets("Foaie1").Range("AL" & 10 + i) / 100
SumaCtrl = SumaCtrl + Worksheets("Foaie1").Range("AO" & 10 + i)

Worksheets("Foaie1").Range("AP" & 10 + i) = InputBox("Percentage of profit for
labor motivation (%): ", "Percent of profit for labor", 10)
Worksheets("Foaie1").Range("AP" & 10 + i) = Worksheets("Foaie1").Range("AP" &
10 + i) * Worksheets("Foaie1").Range("AL" & 10 + i) / 100
SumaCtrl = SumaCtrl + Worksheets("Foaie1").Range("AP" & 10 + i)

Worksheets("Foaie1").Range("AQ" & 10 + i) = InputBox("Percentage of profit for
studying the goods markets (%): ", " Percentage of profit for market study", 10)
Worksheets("Foaie1").Range("AQ" & 10 + i) = Worksheets("Foaie1").Range("AQ" &
10 + i) * Worksheets("Foaie1").Range("AL" & 10 + i) / 100
SumaCtrl = SumaCtrl + Worksheets("Foaie1").Range("AQ" & 10 + i)

Worksheets("Foaie1").Range("AR" & 10 + i) = InputBox("Percentage of profit for
advertising goods (%): ", " Percentage of profit for advertising", 15)
Worksheets("Foaie1").Range("AR" & 10 + i) = Worksheets("Foaie1").Range("AR" &
10 + i) * Worksheets("Foaie1").Range("AL" & 10 + i) / 100
SumaCtrl = SumaCtrl + Worksheets("Foaie1").Range("AR" & 10 + i)

Worksheets("Foaie1").Range("AS" & 10 + i) = InputBox("Percentage of profit for
influencing the consumption of good 1 (%): ", " Percentage of profit for good 1", 5)
Worksheets("Foaie1").Range("AS" & 10 + i) = Worksheets("Foaie1").Range("AS" &
10 + i) * Worksheets("Foaie1").Range("AL" & 10 + i) / 100
SumaCtrl = SumaCtrl + Worksheets("Foaie1").Range("AS" & 10 + i)

Worksheets("Foaie1").Range("AT" & 10 + i) =
CDbl(Worksheets("Foaie1").Range("AL" & 10 + i)) - SumaCtrl
Loop Until CDbl(Worksheets("Foaie1").Range("AS" & 10 + i)) > 0
Else
Worksheets("Foaie1").Range("AN" & 10 + i & ":AT" & 10 + i) = 0
```

The decisions regarding the distribution of profit will trigger changes in firm's characteristics in subsequent periods that are detailed in the next section. After meeting the current needs, the market will manifest solvent future demand according to a series of elements that are rather difficult to observe, such as: the product life, changes in household choices of consumption, or other situations.

For this reason, the demand dynamics is modeled through a continuous random variable limited by thresholds that have, at least theoretically, economic relevance (considered between 0.5 and 0.8).

Liquidity level was calculated by adding current values, but the method of calculation may also include present values of cash flows. The same procedure was applied to the level of productive capital of the company.

```
' initialising elements for the new production cycle
' nominalising the next period of time
Worksheets("Foaie1").Range("A" & 11 + i) = Worksheets("Foaie1").Range("A" & 10 + i)
+ 1

' the new market preferences- randomly generated
Worksheets("Foaie1").Range("V" & 11 + i) = 0.5 + 0.3 * Rnd
Worksheets("Foaie1").Range("W" & 11 + i) = 1 - Worksheets("Foaie1").Range("V" & 11
+ i)

' if there is profit to be distributed
If CDbl(Worksheets("Foaie1").Range("AL" & 10 + i)) > 0 Then

' present value of liquidities
Worksheets("Foaie1").Range("C" & 11 + i) = Worksheets("Foaie1").Range("C" & 10 + i)
+ Worksheets("Foaie1").Range("AN" & 10 + i)

' current capital
Worksheets("Foaie1").Range("E" & 11 + i) = Worksheets("Foaie1").Range("E" & 10 + i)
' the cost of capital remains the same

Worksheets("Foaie1").Range("H" & 11 + i) = Worksheets("Foaie1").Range("H" & 10 + i)
+ Worksheets("Foaie1").Range("AO" & 10 + i)
```

The income available for purchases is defined by a random variable used to simulate the influence of favorable or unfavorable factors, and also includes the advertising factor with funds allocated periodically in the AR column.

```
' disposable income
NorocFM = Rnd
If NorocFM > 0.5 Then
Worksheets("Foaie1").Range("U" & 11 + i).Interior.Color = RGB(195, 160, 255) ' violet
Else
Worksheets("Foaie1").Range("U" & 11 + i).Interior.Color = RGB(230, 250, 210) '
galbeior
End If

Worksheets("Foaie1").Range("U" & 11 + i) = Worksheets("Foaie1").Range("U11") + (0.8
+ NorocFM) * Worksheets("Foaie1").Range("AR" & 10 + i)
```

The funds awarded as incentive for labor have a threshold effect and reaching the threshold triggers permanent motivational resorts of labor (conscientious in their efforts), resulting in gradual increase of employment elasticity in the production function.

```
' the influence of labor motivation
totalMotivatieFM = totalMotivatieFM + Worksheets("Foaie1").Range("AP" & 10 + i)
If totalMotivatieFM >= prag Then
If Trim(Worksheets("Foaie1").Range("I" & nr_crt_FM + 1)) = "" Then
nr_crt_FM = nr_crt_FM + 1
Worksheets("Foaie1").Range("I" & nr_crt_FM) = (1 - Worksheets("Foaie1").Range("H1")
- Worksheets("Foaie1").Range("I" & nr_crt_FM - 1)) * 0.5 * Rnd +
Worksheets("Foaie1").Range("I" & nr_crt_FM - 1)
Worksheets("Foaie1").Range("K" & 11 + i) = "=$C$1*($F$1*H11)^$H$1*I11^$I$" &
nr_crt_FM 'the production function modifies
End If

totalMotivatieFM = 0    'motivation is manifesting
prag = 2 * prag         ' the effect manifestation threshold for labor motivation increases
End If
```

The information that the market preferences study provides is represented by the degree of the accuracy of "guessing" market shares for each product, which is simulated by generating a normal variable, whose dispersion involves the market research funds over the available income as part of market momentary preference for good 1. The second weight is complementary to the first one towards unity.

```
' the influence of market study
Elast1 = GenNrAleat(CSng(Worksheets("Foaie1").Range("V" & 11 + i)),
CSng(Worksheets("Foaie1").Range("AL" & 10 + i) / 1000 /
Worksheets("Foaie1").Range("AQ" & 10 + i) * Worksheets("Foaie1").Range("V"& 11+i)))
```

The last part indicates the influence of targeted advertising on the demand of each product, represented as a percentage of allocations to profit from the previous demand.

```
' the influence of col. AS /AT – the increase in consumption is proportional with the ratio
[(column cost/ disposable income calculated with NorocFM)]
Worksheets("Foaie1").Range("Y" & 11 + i) = 1.05 * Worksheets("Foaie1").Range("AS" &
10 + i) / Worksheets("Foaie1").Range("U" & 10 + i) * Worksheets("Foaie1").Range("Y" &
10 + i)
Worksheets("Foaie1").Range("Z" & 11 + i) = 1.05 * Worksheets("Foaie1").Range("AT" &
10 + i) / Worksheets("Foaie1").Range("U" & 10 + i) * Worksheets("Foaie1").Range("Z" &
10 + i)
End If
Next i
```

3. Running the program

As mentioned before, solving the discretized model is quite difficult when there is a sufficiently large number of decision variables involved and a more useful alternative is to use scenarios. We consider the following two situations:

Scenario 1. Company is operating under favorable conditions (high level of income for purchasing goods, as depicted in Table 1.3 from Annex), with a production sales level that allows hiring additional inputs. Such a situation is described by the results presented in Tables 1.1- Tables1.5 (see Annex):

Under this scenario, the company obtains profit without having to make a consistent effort. However, comparing the level and structure of market demand with the levels and structure of production, we notice that the company fails to correctly estimate the demand for its goods, consistently producing less than required by the market (Table 1.3). Moreover, the structure of production is kept the same for all 10 periods and the prices are fixed, as the company does not react to the information coming from the market (Table 1.2).

Table 1.2. Decisions regarding production and price under scenario 1

Time	*Distribution of production*		*Firm's produced quantities*		*Firm's established price*	
	Good 1	*Good 2*	*Good 1*	*Good 2*	*Good 1*	*Good 2*
1	40%	60%	63.21	94.82	25	10
2	40%	60%	64.18	96.28	25	10
3	40%	60%	65.82	98.74	25	10
4	40%	60%	66.59	99.89	25	10
5	40%	60%	67.81	101.72	25	10
6	40%	60%	67.32	100.98	25	10
7	40%	60%	67.24	100.86	25	10
8	40%	60%	69.69	104.53	25	10
9	40%	60%	65.93	98.89	25	10
10	40%	60%	69.42	104.12	25	10

The lack of reactivity of the firm given the information generated by the market response to its sales prices is a factor that contributes to the moving away from its optimality decision level, as the profit recorded is lower than its potential value and the company is not taking full advantage of the existing opportunities.

The relatively high share of cash indicates a prudential attitude that is generating "costs" since investing in raising capital may have resulted in significantly higher profits (Table 1.5).

Also, the salary level is quite high considering that the random variables signifying labor response to the announced level are rather unfavorable to employment.

Scenario 2. The company operates in highly competitive conditions, with a level of potential sales close to the level of production capacity. This situation is described by the results presented in Tables 2.1.-Tables 2.5 in Annex:

Under this scenario, the company has to face a reduction of disposable income by 50%, which forces the management of the company to undertake a significantly more responsible approach regarding the aggregated firm decision system.

First, labor costs are reduced by 20%, which incur lower production costs. Capital is kept at the same level and there is little variation in labor as the management is now interested in keeping the production costs under control.

The structure of production and flexibility of prices might signal the transformation of the company and its willingness to take market conditions into account and adjust accordingly.

Table 2.2. Decisions regarding production and price under scenario 2

Time	*Distribution of production*		*Firm's produced quantities*		*Firm's established price*	
	Good 1	*Good 2*	*Good 1*	*Good 2*	*Good 1*	*Good 2*
1	50%	50%	82.12	82.12	20	20
2	70%	30%	117.56	50.38	18	18
3	70%	30%	116.87	50.09	12	15
4	60%	40%	95.88	63.92	12	10
5	40%	60%	65.98	98.96	10	10
6	45%	55%	71.20	87.02	10	10
7	40%	60%	65.37	98.05	15	10
8	50%	50%	82.72	82.72	20	10
9	70%	30%	116.52	49.94	18	10
10	40%	60%	65.77	98.66	15	8

However, the low demand, which often goes under the production capacity of the firm, generates large stocks, which incur supplementary costs that lower the profit even more. Keeping stocks at lower levels by harmonizing production structure and prices decisions with information regarding their previous level becomes essential for the company.

3. Conclusions

In this paper, we present a model that considers both production and sales subsystems and develop a computer program to simulate the dynamic evolution of a firm, taking into consideration two possible scenarios.

Under the first scenario, the company benefits from favorable development conditions obtaining profit without having to make a consistent effort to determine the optimum decision. Thus, it can be stated with certainty that the decision system is not optimal because:

- in all periods the level and structure of market demand differ from the levels and structure of production, which means that the production decisions are suboptimal;
- the share of cash (relatively high) indicates a prudential attitude, but this attitude is generating "costs" since investing in raising capital could result in obtaining significantly higher profits;
- the salary level is quite high considering that the random variables signifying labor response to the announced level are rather unfavorable to employment;
- non-reactivity of the firm given the information generated by the market response to sales prices (potentially justified by the demand structure evolution uncertainty) is also a factor that removes the firm from its optimality decision level;

Under the second scenario, the company has to face significantly harsher conditions. Reducing initial income by 50% forces the management of the company to undertake a significantly more responsible approach regarding the aggregated firm decision system. In this case, the main measures considered were:

- reducing production costs by decreasing labor costs ;
- keeping stocks at lower levels by harmonizing production structure and prices decisions with information regarding their previous level;
- flexibility needed in prices levels combined with increased funding for target advertising and advertising in general.

Making a quick comparison between the two scenarios of evolution, we can observe the importance of the market disposable income for purchases, and chain effects that its dynamics has on the phenomenon of stocks formation, corroborated with the degree of competition and incomplete information. Given hypothetical conditions (not accounted for in the model) to stop production (which would have negative repercussions on firm's goodwill), existing stocks and related costs would decrease and lead to revaluation of the income limit at which the company may carry on the activity in a profitable manner.

Another important factor which the company should consider is its **pricing policy**. The pricing policy is the main modality of testing the market and

constitutes one of the decisive factors in the firm's evolutionary trend under intensely competitive economic situations or crises.

If under the first scenario, the company could enable pricing strategy under the existence of a sufficient solvable demand, in the other case, the company seeks to match the response (price) to harsh economic reality (competition) that is generating negative effects on firm (stock of goods).

In conclusion, the economic well-functioning of a company requires the implementation of a policy mix carefully oriented towards the economic changes of firm's environment, using price, costs of production factors and their substitution possibilities, as well as different mechanisms (for gathering information regarding potential buyers' preferences or for influencing consumption through advertising / promotional offers) as key factors.

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ANNEX 1

Time	*Cash*	*Inputs Costs*		*Inputs Availability*		*Production costs*	*Total production*
		Capital	*Labor*	*Capital*	*Labor*		
1	1000.0	1	5	10000.00	150	1250.00	158.04
2	1478.0	1	5	10179.25	153	1273.96	160.47
3	2027.6	1	5	10385.33	159	1314.27	164.57
4	2527.2	1	5	10572.71	161	1333.64	166.50
5	3084.8	1	5	10781.74	165	1364.09	169.54

6	3559.6	1	5	10959.84	161	1352.99	168.30
7	4064.4	1	5	11149.18	159	1352.46	168.11
8	4588.4	1	5	11345.67	169	1412.28	174.23
9	5007.2	1	5	11502.77	150	1325.14	164.82
10	5727.6	1	5	11772.93	164	1408.65	173.54

Table 1.1. Production costs and input availability under scenario 1

Time	*Disposable Income*	*Marginal Utility*		*Market Demand*		*Sales*		*Total Income*
		Good 1	*Good 2*	*Good 1*	*Good 2*	*Good 1*	*Good 2*	
1	3000.00	0.50	0.50	60.00	150.00	60.00	94.82	2448.24
2	3190.20	0.69	0.31	89.25	102.14	67.40	96.28	2647.85
3	3301.19	0.72	0.28	98.02	92.41	65.83	92.41	2569.76
4	3290.74	0.58	0.42	78.95	138.44	66.60	106.23	2727.18
5	3265.31	0.74	0.26	98.76	87.07	67.82	87.07	2566.09
6	3286.04	0.71	0.29	95.89	95.27	67.32	95.27	2635.63
7	3232.86	0.69	0.31	91.93	100.22	67.24	100.22	2683.34
8	3244.90	0.77	0.23	101.96	76.63	69.69	76.63	2508.56
9	3127.86	0.52	0.48	66.73	151.60	65.93	147.80	3126.23
10	3351.22	0.62	0.38	85.02	132.18	69.42	104.13	2776.70

Table 1.3. Market conditions under scenario 1

Time	*Stocks*		*Inventory Costs*		*Gross Profit*
	Good 1	*Good 2*	*Good 1*	*Good 2*	
1	3.22	0.00	3.22	0.00	1195.02
2	0.00	0.00	0.00	0.00	1373.88
3	0.00	6.33	0.00	6.33	1249.16
4	0.00	0.00	0.00	0.00	1393.55
5	0.00	14.65	0.00	14.65	1187.35
6	0.00	20.37	0.00	20.37	1262.27
7	0.00	21.01	0.00	21.01	1309.87
8	0.00	48.91	0.00	48.91	1047.37
9	0.00	0.00	0.00	0.00	1801.09
10	0.00	0.00	0.00	0.00	1368.05

Table 1.4. Storage costs and profits under scenario 1

Time	PROFIT DISTRIBUTION						
	Finance and production factors			Market study	Adver-tising	Induction of artificial demand	
	Cash	*Capital Invest.*	*Incentives*			*Good 1*	*Good 2*
1	478.00	179.25	119.50	119.50	179.25	59.75	59.76
2	549.60	206.08	137.39	137.39	206.08	68.69	68.65
3	499.60	187.37	124.92	124.92	187.37	62.46	62.52
4	557.60	209.03	139.35	139.35	209.03	69.68	69.50
5	474.80	178.10	118.73	118.73	178.10	59.37	59.51
6	504.80	189.34	126.23	126.23	189.34	63.11	63.22
7	524.00	196.48	130.99	130.99	196.48	65.49	65.44
8	418.80	157.11	104.74	104.74	157.11	52.37	52.52
9	720.40	270.16	180.11	180.11	270.16	90.05	90.09
10	547.20	205.21	136.80	136.80	205.21	68.40	68.42

Table 1.5. Distribution of profit under scenario 1

Time	*Cash*	*Inputs Costs*		*Inputs Availability*		*Production costs*	*Total production*
		Capital	*Labor*	*Capital*	*Labor*		
1	1000.0	1	4	10000.00	162	1148.00	164.24
2	1026.3	1	4	10039.41	169	1177.97	167.95
3	1058.2	1	4	10039.41	167	1169.97	166.95
4	1099.4	1	4	10039.41	153	1113.97	159.80
5	1153.7	1	4	10039.41	163	1153.97	164.94
6	1209.6	1	4	10039.41	150	1101.97	158.23
7	1276.4	1	4	10039.41	160	1141.97	163.42
8	1330.7	1	4	10039.41	164	1157.97	165.45
9	1392.5	1	4	10039.41	166	1165.97	166.45
10	1392.5	1	4	10039.41	162	1149.97	164.43

Table 2.1. Production costs and input availability under scenario 2

Time	*Disposable Income*	*Marginal Utility*		*Market Demand*		*Sales*		*Total Income*
		Good 1	*Good 2*	*Good 1*	*Good 2*	*Good 1*	*Good 2*	
1	1500.00	0.50	0.50	37.00	38.00	37.00	38.00	1500.00
2	1649.41	0.55	0.45	51.34	40.96	51.34	40.96	1661.40
3	1745.30	0.65	0.35	94.52	42.79	94.52	42.79	1776.15
4	1813.20	0.73	0.27	111.17	51.42	111.17	51.42	1848.23
5	1831.77	0.53	0.47	98.75	89.43	98.75	89.43	1881.76
6	1833.00	0.62	0.38	115.58	75.04	115.58	75.04	1906.18
7	1746.57	0.61	0.39	73.21	73.94	73.21	73.94	1837.61

8	1836.51	0.60	0.40	58.59	78.53	58.59	78.53	1957.05
9	1912.05	0.75	0.25	81.04	56.92	81.04	56.92	2027.84
10	1675.42	0.50	0.50	57.45	115.60	57.45	115.60	1786.55

Table 2.3. Market conditions under scenario 2

Time	*Stocks*		*Inventory Costs*		*Gross Profit*
	Good 1	*Good 2*	*Good 1*	*Good 2*	
1	45.12	44.12	45.12	44.12	262.76
2	111.34	53.54	111.34	53.54	318.54
3	133.69	60.84	133.69	60.84	411.65
4	118.40	73.34	118.40	73.34	542.52
5	85.63	82.87	85.63	82.87	559.28
6	41.25	94.86	41.25	94.86	668.10
7	33.40	118.97	33.40	118.97	543.27
8	57.54	123.16	57.54	123.16	618.38
9	93.02	116.18	93.02	116.18	652.67
10	101.34	99.24	101.34	99.24	435.99

Table 2.4. . Storage costs and profits under scenario 2

Time	**PROFIT DISTRIBUTION**						
	Finance and production factors			**Market study**	**Adver-tising**	**Induction of artificial demand**	
	Cash	*Capital Invest.*	*Incentives*			*Good 1*	*Good 2*
1	26.30	39.41	26.28	26.28	118.24	13.14	13.11
2	31.90	0.00	31.85	31.85	143.35	15.93	63.66
3	41.20	0.00	41.16	41.16	185.24	20.58	82.29
4	54.30	0.00	54.25	54.25	244.14	27.13	108.46
5	55.90	0.00	55.93	55.93	251.68	27.96	111.88
6	66.80	0.00	66.81	66.81	300.65	33.41	133.63
7	54.30	0.00	27.16	27.16	244.47	81.49	108.68
8	61.80	0.00	30.92	30.92	247.35	30.92	216.47
9	0.00	0.00	32.63	65.27	163.17	32.63	358.97
10	43.60	0.00	43.60	43.60	196.20	21.80	87.20

Table 2.5. Distribution of profit under scenario 2.